Interdisciplinary data education

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Teaching Primary and Secondary learners how to be data citizens

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ABSTRACT

As the use of data science continues to permeate business and civic life, school systems must adapt to prepare young people not only for employment in data related roles, but also to be active citizens within a data society. This workshop introduces the Data Education in Schools project which is designed to educate 3-18 year old learners about data across the curriculum. We will present an interdisciplinary curriculum framework for data education, based on the PPDAC cycle for statistical literacy and adapted for the Scottish Curriculum for Excellence. We will illustrate how values-based authentic problem solving projects related to real world data can integrate curriculum outcomes from computer science, mathematics and the social subjects. We will explain the rationale for the new Data Science qualification for school learners which is now offered by the Scottish Qualifications Authority. Workshop attendees be invited to share information and experiences about data education from their own educational settings and act as critical friends to improve the Data Education in Schools project.

CCS CONCEPTS

• Social and professional topics~Model curricula • Social and professional topics~K-12 education

KEYWORDS

Computer science education; data literacy; school curriculum

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1 Data Education in Schools

There is a growing demand in industry for people with Data Science skills [2] and a growing understanding that our societies need citizens who are data literate [1]. In order to satisfy this demand, universities are responding with more data science courses [4]. However, to educate the population more generally, schools also need to support learners to develop data literacy [5]. 'Data Education in Schools'(DES) is a Scottish Government funded project to teach data literacy and data citizenship skills to learners ages 3-18 years old in the Edinburgh and surrounding area. It is an eight year project that aims to reach all learners within six local authorities in 527 Primary and Secondary and Special schools. The project will source and develop teaching materials and provide professional learning for educators.

The goal is for young people to drive data innovation and for them to be informed critical activists about data in society (*data citizens*). All learners should have the data skills they need to understand and utilise data to benefit themselves and their communities. Some learners may then choose to specialise by learning additional technical skills (such as interpreting visualizations, understanding and critiquing data analysis choices and making decisions informed by data) which will enable them to take on roles as *data workers* when they leave school. Learners who are particularly interested in data science may choose a *data professional* career path beginning with college or university studies.

In order to carry out this project effectively we needed to carry out an audit of the existing national curriculum to identify areas where data and information handling skills may already be being taught, opportunities to embed and expand data literacy skills, and curricular outcomes that could be enriched by teaching using data as a context or stimulus.

Given that Scottish teachers already report high levels of workload stress [3], it is unreasonable to expect teachers to teach another subject in addition to their current workload. For this reason, the DES project will support and enrich the existing curriculum rather than introducing a new strand within the curriculum. The Data Education in Schools project offers a professional learning programme to upskill a wide range of teachers from different sectors and subject specialisms to give

them the confidence and knowledge in using and teaching data skills.

The Scottish curriculum

The Scottish curriculum, the Curriculum for Excellence (https://scotlandscurriculum.scot) is a national curriculum for all learners aged between three and eighteen years old. The phase for Early Years, Primary and lower Secondary is called 'Broad General Education' and consists of outcomes in eight different curricular areas (expressive arts, languages, health and wellbeing, mathematics, religious and moral education, science, social studies, technologies). Learners experience outcomes across all eight curricular areas. Once learners reach the senior phase (around the age of fifteen) they can select subject choices to study towards qualifications and awards.

The Data Education framework focused on the curricular Outcomes that form the Broad General Education phase of the national curriculum. In the Senior phase of the curriculum, learners select from a wide range of qualifications to study, each with their own curricular outcomes.

In Scotland, a qualification has been introduced in 2019 for teaching Data Science, the National Progress Award (NPA) in Data Science at SCQF Levels 4, 5 and 6 (intended for learners aged 15 years and above).

One of our aims for the Data Education in Schools project is to ensure that learners gain an appreciation within the Broad General Education for the varied and rich opportunities for applying data literacy skills and that they progress on to the Senior Phase with a good understanding of the importance and desirability of Data Science skills in the workplace.

A Framework for Data Education

In a review of previous literature on data literacy, Wolf and colleagues [5] define data literacy as "the ability to ask and answer real-world questions from large and small data sets through an inquiry process, with consideration of ethical use of data". They describe a space of data literacy skills, using the PPDAC cycle in which learners iteratively move through the stages of Problem, Plan, Data, Analysis and Conclusions. Using real world contexts for problem solving, and considering the ethical issues are important in all stages of the cycle.

Thirteen curricular documents for the Scottish curriculum were searched, in particular focusing on Outcomes and 'Benchmarks' (which are examples of assessment opportunities). The aim was to identify two types of Outcomes: outcomes that involve learning data literacy skills, and those that provide an opportunity to apply those skills. For brevity, we focus on the former skill set here. Table 1 gives a summary of the number of existing curriculum outcomes relating to the PPDAC cycle for the relevant curricular areas. It can be seen that although data skills have recently come to prominence, a considerable number of relevant curricular outcomes can be found in the existing curriculum. The task for DES is to synthesise and present cross curricular learning contexts so that the PPDAC cycle can be taught in a coherent way.

	Problem	Plan	Data	Analysis	Conclusions	Ethics
Computing	0	0	11	4	0	0
Maths	1	4	1	10	8	0
Literacy	0	0	0	2	6	0
Social Studies	5	8	3	3	6	4
Technologies	0	0	0	3	2	0
Digital literacy	0	4	2	2	2	0
Total	6	16	17	24	24	4

Table 1. Curriculum outcomes for learning data skills applied to PPDAC

Workshop Participation

We invite workshop participants to offer constructive criticism of the data education curriculum framework, to help identify areas which are important to data education but which are not emphasized or prioritized clearly enough. We invite suggestions and experiences about suitable cross curricular projects which have worked in other educational settings. We are particularly keen to hear about examples of good practice from other countries.

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